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Synchrotron microbeam X-ray diffraction (μXRD) imaging of environmental samples in-situ using a Bruker CCD area detector

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Beamline(s): X26A

Introduction: This past cycle beamline X26A has installed a dedicated Bruker x-ray area detector to the beamline for microbeam x-ray diffraction analysis of environmental materials *in-situ*. The instrument and techniques we have developed for its use at X26A have proven very successful in it's initial use. One of the techniques we are currently developing for environmental studies is the use of this system for in-situ x-ray microbeam diffraction imaging. The technique is complementary to the other microprobe techniques currently employed at the beamline and promises to provide environmental and geoscientists the ability to image the mineralogy of a sample with micron spatial resolution as a complement to the chemical imaging already possible.

Methods and Materials: In the technique being developed a ca. 10 μm focused monochromatic beam (using Kirckpatrick Baez focusing optics) is scanned through a sample of interest. Fluorescence imaging is accomplished by rastering the sample through the beam and detecting the energy dispersive fluorescence generated using a Canberra Si(Li) solid state detector mounted 90° to the incident beam. The simultaneous diffraction is captured in transmission mode using a Bruker SMART 1500 CCD area detector. The SMART software is written specifically to talk to the Bruker General Goniometer Control System (GGCS) motor/shutter controller, so to synchronize the rastering of the sample with the image collection of the CCD SMART must believe it's communicating with a GGCS system. The solution developed by Mark Rivers (U. Chicago/CARS) is to make an EPICS IOC emulate the GGCS, so that the SMART software thinks it is talking to a GGCS, while it is actually communicating with EPICS. Diffraction images can then be collected for each pixel. To image given two theta regions we have developed an IDL based program that will read a series of CHI integration files from the program FIT2D, which allows for rapid integration of image series, extracts the intensity of a given two theta region, and then plots the data as a false color 2D mage.

Results: The technique has proven successful in imaging the mineralogic distributions in soil samples.

Conclusions: Microbeam diffraction imaging is a natural extension of the compositional imaging currently employed at the beamline.

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